REPORT 42

SWEEP

SOIL AND WATER

ENVIRONMENTAL

ENHANCEMENT PROGRAM

PAMPA

PROGRAMME D'AMELIORATION

DU MILIEU PEDOLOGIQUE

ET AQUATIQUE

Canada

Ontario

SWEEP

is a $30 million federal-provincial agreement, announced May 8, 1986, designed to improve soil and water quality in southwestern Ontario over the next five years.

PURPOSES

There are two interrelated purposes to the program; first, to reduce phosphorus loadings in the Lake Erie basin from cropland run-off; and second, to improve the productivity of southwestern Ontario agriculture by reducing or arresting soil erosion that contributes to water pollution.

BACKGROUND

The Canada-U.S. Great Lakes Water Quality Agreement called for phosphorus reductions in the Lake Erie basin of 2000 tonnes per year. SWEEP is part of the Canadian agreement, calling for reductions of 300 tonnes per year — 200 from croplands and 100 from industrial and municipal sources.

PAMPA

est une entente fédérale-provinciale de 30 millions de dollars, annoncée le 8 mai 1986, et destinée à améliorer la qualité du sol et de l'eau dans le Sud-ouest de l'Ontario.

SES BUTS

Les deux buts de PAMPA sont: en premier lieu de réduire de 200 tonnes par an d'ici 1990 le déversement dans le lac Erie de phosphore provenant des terres agricoles, et de maintenir ou d'accroître la productivité agricole du Sud-ouest de l'Ontario, en réduisant ou en empêchant l'érosion et la dégradation du sol.

SES GRANDES LIGNES

L'entente entre le Canada et les États-Unis sur la qualité de l'eau des Grands Lacs prévoyait de réduire de 2 000 tonnes par an la pollution due au phosphore dans le bassin du lac Erie. PAMPA fait partie de cette entente qui réduira cette pollution de 300 tonnes par an — 200 tonnes provenant des terres agricoles et 100 tonnes provenant de sources industrielles et municipales.

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TECHNOLOGY EVALUATION AND DEVELOPMENT SUB-PROGRAM

REPORT ON DEVELOPMENT AND OPERATION OF THE CROSS-SLOT PLANTER

FINAL REPORT

March, 1992

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Disclaimer:	The views contained herein do not necessarily reflect the views of the Government of Canada or the SWEEP Management Committee.

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CROSS-SLOT PLANTER EVALUATION

REPORT TO SWEEP

by
J. Rigby and J.A. Underwood for the

Rondeau Agricultural Conservation Corporation

1.0 INTRODUCTION

Normal openers used for planters produce a "V" or "U" shaped opening. The "V" shape is usually produced with a double or triple disc. The seed is dropped into the bottom of the "V". Some problems with germination can occur if the opening is not closed up or if the soil on the sides of the "V" are smeared and compacted.

The "U" shaped slots are created by several methods. Various hoes flat-angle discs and power-till openers are all used to create the "U" shaped opening. The "U" openings have advantages over the "V" openings in producing a more optimal seed-zone micro environment. This system does require removing residues which can cause loss of moisture under certain conditions. There may be a loss of soil seed contact if moisture conditions are not right.

Massey University (Palmerston North-New Zealand) began developing a cross-slot planter in 1969. The concept of this planter was to place the seed and fertilizer on either side of the coulter using wings which formed a cross slot under the soil surface. The soil was lightly compacted on the seed to give a micro climate suitable for good germination. Figure 8 gives a visual comparison of a "V" and cross-slot opening.

This no-till planting technology was developed for planting grain. Increased germination rates and higher yields were noted for wheat and other grains.

2.0 INTRODUCTION TO ONTARIO

The concept of the cross slot planter being used for corn and soybeans for no-till planting in Ontario was first proposed in 1989. During the 1989-90 season a program was developed through SWEEP to evaluate the cross-slot planter as a no-till planting system. The opener units had to be adapted to a corn planter system.

One advantage would be the elimination of trash skimmers ahead of the planting shoe plus the concept of seed and fertilizer placement in a better micro-climate.

Due to some redesign of the wings in New Zealand, the seed placement units did not arrive until the winter of 1990-91. The planter was used to plant corn and soybeans during the 1991 season.

A White Air Planter was lent to the project by the White-New Idea Company.The planter had to be reconfigured to accommodate the cross-slot openers. The seed metering units had a flat base which made it easier to fabricate a support mechanism on the cross-slot openers.

The seed was directed down the wing on one side of the coulter while liquid fertilizer was applied through the wing on the other side. The wing and coulter are shown in Fig. 1.

3.0 PLANTER-DETAILS

3.1 FRAME

The White Air Planter frame ,lift mechanism and tongue were used as the basic carrying unit. The cross-slot opener units could not be attached to the existing frame as they conflicted with the lift mechanism and the wheels. The planter was double framed as shown in Fig. 2, with a second 4 in.x 6 in. tubular steel tool bar set back 44 inches from the original. The new tool bar was attached with two 3 in. x 6 in. tubular steel stretchers which had a mounting plate welded to one end and were welded to the second tool bar.The stretchers were attached to the original tool bar with U bolts on the mounting plate. This located the opener mechanisms and seed metering behind the wheels and lift mechanism.
Later a piece of 5 in. x 1/2 in. steel was added between the two tool bars on the ends to accommodate suitcase weights.

The lift mechanism used to raise and lower the planter frame was controlled from the tractor cab by the tractor hydraulics.

3.2 CROSS SLOT OPENERS

The cross-slot opener for seed and fertilizer placement consists of a cast metal wing on each side of a single disc or coulter. The diagram in Fig. 3 details the coulter, wings or bio-blade and the press wheel.

3.3 WINGS

The wings are mounted on a hinge mechanism at the top. Pressure is applied to the wings by a rubber pad to hold them tight to the coulter.The wing is flush to the coulter on the leading edge but the back of the wing is open to allow seed and fertilizer to drop down to the slot formed at the bottom of the wing. The seed is allowed to travel down the wing on one side of the coulter and fertilizer down the other.

3.4 PRESS WHEELS

The centerline of the press wheels are mounted slightly behind the centerline of the coulter. The pressure point of the press wheels occurs where the coulter exits the soil. A minimum of soil is then carried up on the coulter and the soil is firmed around the seed.

3.5 ATTACHMENT TO THE FRAME

The opener and press wheels are mounted on the extended frame with U bolts on a mounting plate. The opener units have a parallel linkage system to allow them to float on uneven ground.

Down pressure is activated by a hydraulic cylinder attached to the bottom link of the parallel system as shown in Fig. 4. The hydraulic cylinders to each unit are connected in parallel. This allows the opener units to float with constant pressure on all units. The actual down pressure is the difference in total force on each end of the cylinder less the area occupied by the ram at the lower end. An accumulator was placed in the hydraulic line to compensate for volume variations. Fig. 5 diagrams the hydraulic connection between the hydraulic cylinders. The initial no load pressure on the accumulator was set at approximately 800 psi. The hydraulic pressure on the system varied from 1100 to 1400 psi. The pressure used depends on the soil conditions.

3.6 SEED METERING

The seed metering was accomplished with four White Air Planter units which have a flat base. A mounting platform was fabricated which attached to the opener unit. This allowed easy mounting of the units on the cross slot-openers. The metering disk for soybeans and the mounting plate are shown in Fig. 6. Air was supplied to the metering seed plates, from a fan run by a hydraulic motor which was standard equipment on the planter. PCV pipe was run to each planter unit on the extended frame from the original air supply manifold.

The drive mechanism for metering was accomplished by roller chain and shafts from both of the carrying wheels on the planter frame. By means of sprockets and roller chain, rotation was transferred to a transmission which had a variety of sprockets available for altering the seeding rate. The rotation was then transferred to the main stub shaft. A drive shaft was mounted on the extended frame and driven by roller chain from the stub shaft. The drive shaft transferred the rotation to the seed metering units. The shaft on the extended frame was mounted about 10 inches above the frame so the seed metering units could be driven without the use of chain tensioning devices.

3.7 SEED DROP TUBE

Transporting the seed from the seed metering unit to the opener was accomplished by retrofitting the seed tube from the White planter. The seed tube was reversed and shortened. The plastic connector on the cross slot opener was shortened and remoulded to fit the seed tube using a heat gun. The upper end of the seed tube was held in place with a metal sleeve which fit into the support bracket and the seed tube. Fig. 7 details the seed tube as retrofitted to the planter.

4.0 OPERATION

The planter units were set at 30 inch spacing. Both corn and soybeans were planted with the system.

The travel speed for corn was 4.5 miles/per hour. Liquid fertilizer was added at the time of planting.Soybeans were planted at 7 miles/per hour with no fertilizer added with the planting operation.

Corn research plots were planted for phosphorous trials conducted by Dr. Murray Miller, Land Resource Science ,University of Guelph.

5.0 OPERATION PROBLEMS AND SOLUTIONS

5.1 PLANTER WEIGHT

The carrying frame and planter units were not heavy enough to keep the planter in the ground under certain soil conditions. An additional 5 x 1/2 inch piece of steel was added at either end between the original frame and the extended frame. Suitcase weights were then hung on this addition to provide additional weight.

5.2 DOWN PRESSURE ON THE OPENER UNITS

Under certain soil conditions the planter units required additional hydraulic pressure to hold the opener units in the ground. The pressure on the hydraulic system could be varied from 1100 to 1400 psi dependent on the soil conditions. The no load head pressure of 800 psi on the accumulator allowed flexibility of the system when the hydraulic system was charged to the operating pressure.

The use of hydraulic cylinders for down pressure, rather than spring loading, created an even down pressure on all planting units on uneven ground conditions since the hydraulic pressure is equal over the four units. The planter units do not bounce as might be expected with spring loaded units.

5.3 COULTER BLADES

The original coulter blades were not tempered properly. The coulters tended to wobble slightly. This caused the wings to flex, allowing some residue to get caught between the wing and the coulter. New coulter blades are being made of high quality steel.

5.4 SEED DISPLACEMENT

The original system was designed for small grains. Occasionally a seed such as a large corn kernel would get caught between the wing and the coulter. The seed would then roll between them and be deposited on the top of the ground. Agri-Systems are redesigning the wing to provide more clearance to accommodate larger seeds.

6.0 CONCLUSIONS

Where tillage has been reduced it has been necessary to use zone tillage in planting operations to get a good micro climate for seed germination. The cross-slot planter has reduced or eliminated a number of these concerns. Hair pinning of residue in the seed slot has been eliminated. There is no need for tillage coulters and double disk openers which reduces equipment and power requirements.

The crusting around the seed has been eliminated and the smearing of moist soil has been reduced with the cross-slot planter. There is less disturbance of the soil around the seed zone thus, the mycorrhizal effect is maintained, thus speeding up germination and growth. The amount of testing in 1991 was limited. The results however, look good and a continuation of this program with expanded testing and evaluation would be encouraged for the 1992 growing season.

A SWEEP report authored by Dr. Murray Miller,Land Resource Science, University of Guelph is available 'Comparison of Planters and Fertilizer Application Systems for No-Till Corn' which gives research results on the effectiveness of the cross-slot planter.

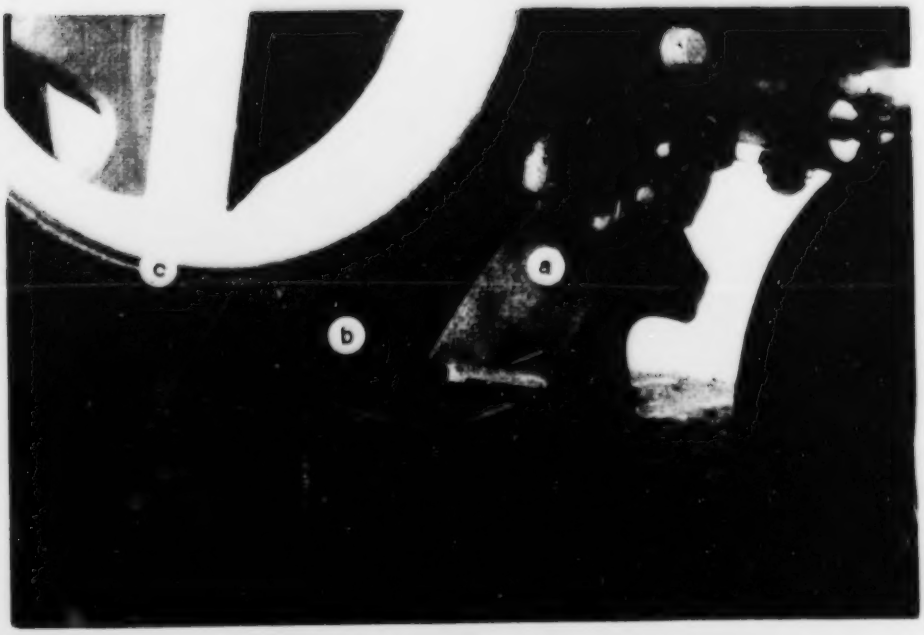

FIG. 1 CROSS SLOT OPENER SHOWING THE WING 'a', COULTER 'b', AND THE PRESS WHEEL 'c'.

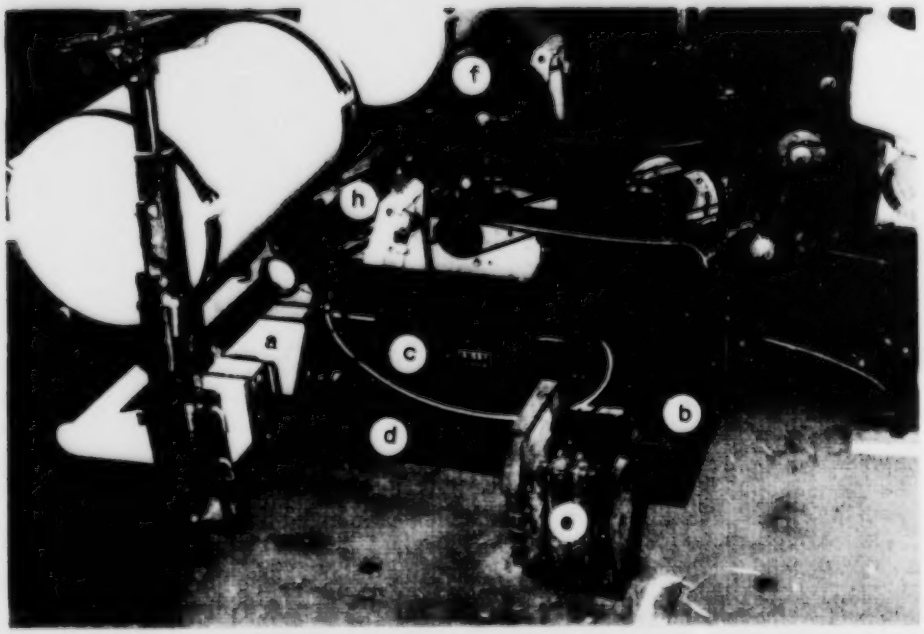

FIG. 2 WHITE PLANTER WITH AN EXTENDED FRAME, AS A TOOL BAR TO CARRY THE PLANTING UNITS. ORIGINAL FRAME 'a', EXTENDED FRAME 'b', STRECHERS 'c', BAR FOR CARRYING WEIGHTS 'd', SUITCASE WEIGHTS 'e', FAN 'f', AIR MANIFOLD 'H'.

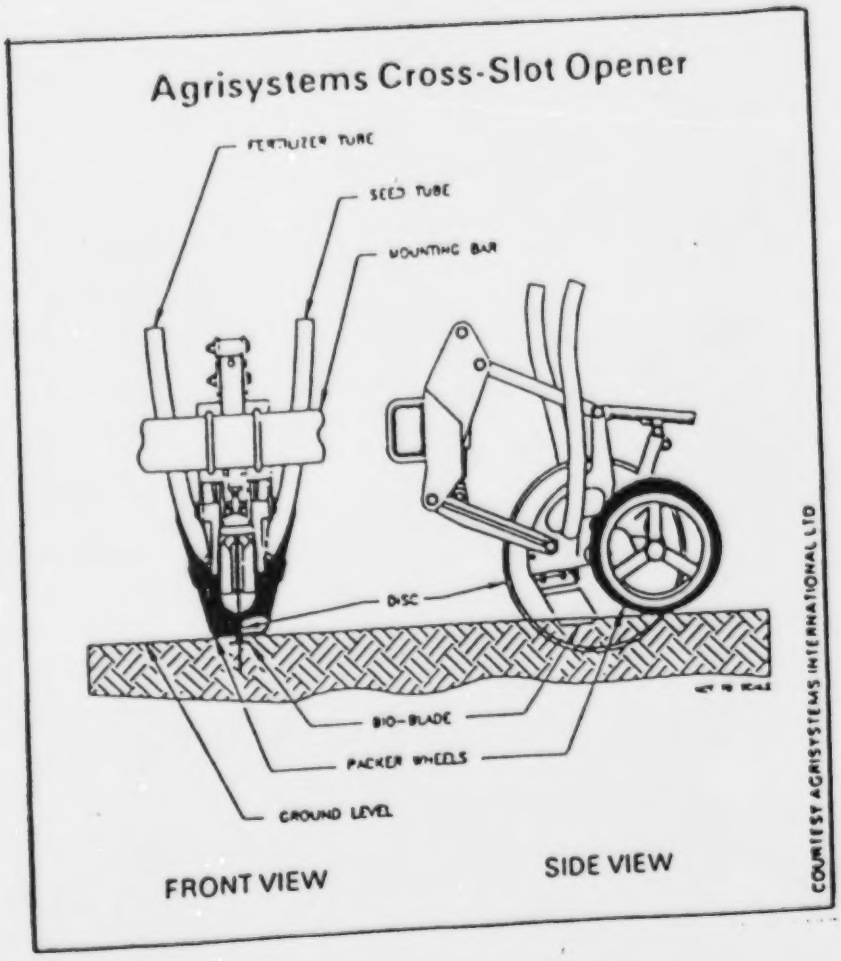

FIG. 3 **THE CROSS-SLOT OPENER SYSTEM DEVELOPED BY AGRISYSTEMS INTERNATIONAL.**

FIG. 4. HYDRAULIC CYLINDER USED TO PUT DOWN PRESSURE ON THE PLANTER UNITS.

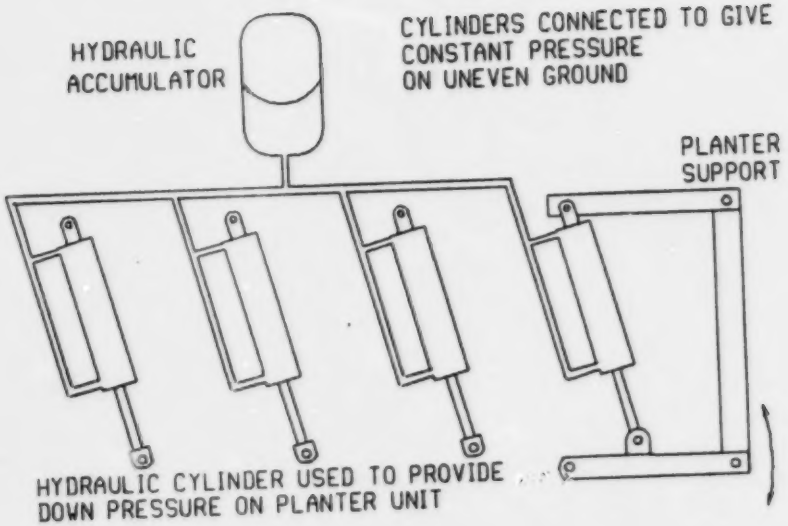

FIG. 5. DIAGRAM OF THE HYDRAULIC CONNECTIONS TO THE CYLINDERS WHICH PROVIDES DOWN PRESSURE TO THE PLANTER UNITS.

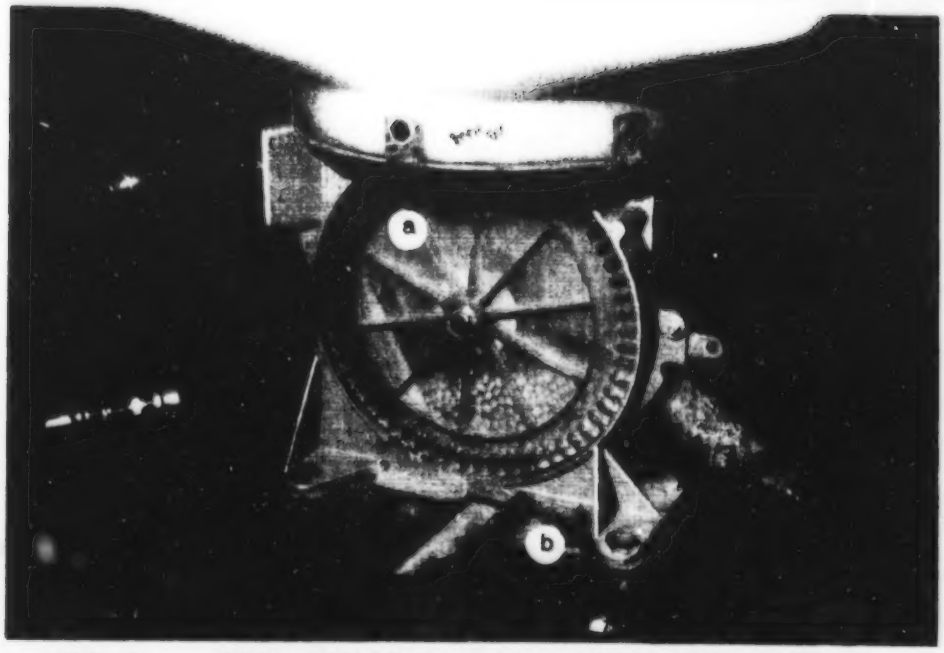

FIG. 6. SEED METERING UNIT SHOWING THE SOYBEAN METERING PLATE 'a' AND THE MOUNTING BRACKET FOR THE SEED METERING UNIT 'b'.

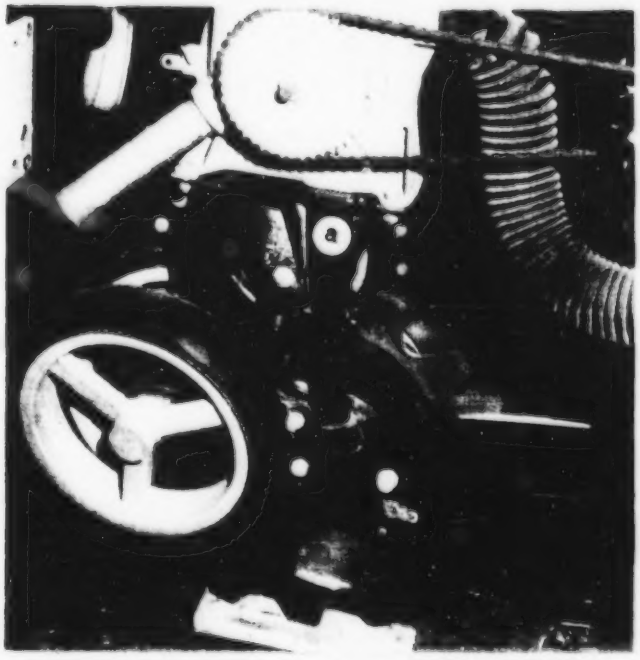

FIG. 7. THE SEED TUBE 'a' WAS RETROFITTED TO PROVIDE A DROP TUBE FROM THE METERING UNIT TO THE CROSS-SLOT OPENER.

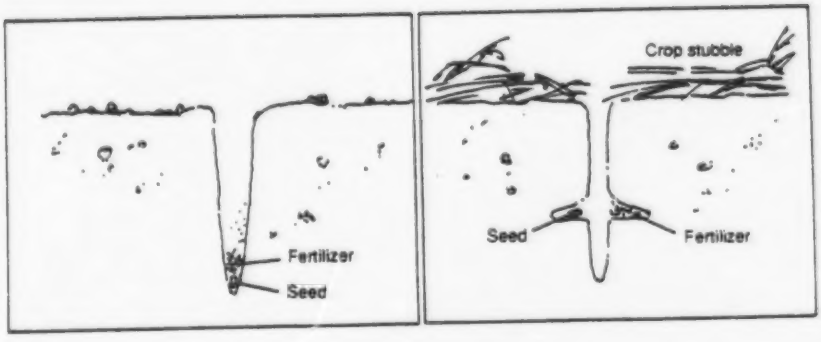

FIG. 8. DOUBLE DISK METHOD (Left); CROSS SLOT METHOD (Right).